IMAGE QUALITY PROCESSING OF A COMPRESSED IMAGE

Background of the Invention

[0001]　　　The present invention relates to the digital image processing arts. It finds particular application in conjunction with processing text symbols in a token based compression system, and will be described with particular reference thereto. However, it is to be appreciated that the invention is applicable to image output processing of any token based or symbol dependent compression technique.

[0002]　　　Typically image output data streams or bitmaps are optimized for particular printers or output devices. However, it is known that not all print engines respond identically even when driven by the same bitmap. The result is that a black and white image on printer A will look somewhat different than the same image produced by printer B. Technology has been developed that receives a bitmapped representation of an entire image or page, recognizes it was produced or generated for a particular printer, and converts or optimizes the bitmap for output on another printer. Typical conversions include morphological operations such as thickening or thinning lines and the like. Unfortunately, when compressed files are routed, the image is typically entirely decompressed, then processed as needed for optimization on a particular output device.

[0003]　　　The present invention contemplates a new method and apparatus to process compressed digital image data which overcomes the above-referenced problems and other.

Summary of the Invention

[0004]   In accordance with one embodiment of the present invention, a method of processing compressed digital image data includes receiving the digital image data compressed according to a defined pattern matching technique, such as JBIG2. The digital image data includes coded image content data and a decoding pattern dictionary which contains image patterns substituted for the coded image content data upon decompression. The image patterns in the decoding pattern dictionary are then either revised and output on the fly, or revised and replaced in the dictionary to be used later in decompressing digital image data. Moreover, the received image patterns in the decoding pattern dictionary may be either compressed or uncompressed.

[0005]   In accordance with another aspect of the present invention, the method further includes replacing the revised image patterns in the dictionary.

[0006]   In accordance with another aspect of the present invention, the method further includes decoding or decompressing the coded image content data with the revised image patterns in the dictionary.

[0007]   In accordance with another aspect of the present invention, the decoding includes parsing the coded image content data, and extracting from the data a pattern location corresponding to a location in the dictionary. The processed image pattern at the extracted location is then output.

[0008]   In accordance with another aspect of the present invention, the processing includes converting the image patterns to grayscale.

[0009]   In accordance with another aspect of the present invention, the processing includes morphological operations on the image pattern in the decoding pattern dictionary.

[0010]   In accordance with another embodiment of the present invention, in an image processing system which receives image data compressed by a pattern matching process, a method of decompressing the image data includes adjusting at least one pattern in a database of stored post-compression patterns where the adjusting is responsive to characteristics of a desired output mechanism or operation. An input pattern location is received corresponding to the adjusted post-

compression pattern in the database and the adjusted post-compression pattern is then extracted from the database.

[0011]   In accordance with another aspect of the present invention, the adjusting includes image processing a plurality of post-compression patterns received with the image data such as morphological processing or grayscale processing.

[0012]   In accordance with another aspect of the present invention, the adjusting includes image processing a first instance of each input pattern location received, for example during real-time decompression operations.

[0013]   In accordance with another embodiment of the present invention, a method of manipulating a data stream in a xerographic image output device includes receiving the data stream including an output pattern dictionary and a coded portion referencing identifiable patterns in the output pattern dictionary. Image processing is applied to an output pattern in the dictionary and the output pattern is replaced with the image processed output pattern.

[0014]   In accordance with another aspect of the present invention, an image processed output pattern corresponding to a symbol location in the data stream is output.

[0015]   In accordance with another aspect of the present invention, the image processing includes adjusting the output pattern for a particular image output device.

[0016]   One advantage of the present invention resides in consistently processed image output tokens for each instance of a designated compressed token.

[0017]   Another advantage of the present invention resides in reduced image output processing times.

[0018]   Other benefits and advantages will occur to others skilled in the art upon a reading and understanding of the following detailed description.

Brief Description of the Drawings

[0019]   The invention may take form in components and various arrangements of components, and in various steps and arrangements of steps. The drawings are

only for purposes of illustrating the preferred embodiments, and are not to be construed as limiting the invention.

[0020] FIGURE 1 is a schematic block diagram of the system suitable to practice an aspect of the present invention; and

[0021] FIGURE 2 is a block diagram of a system suitable to practice another aspect of the present invention.

Detailed Description of the Preferred Embodiments

[0022] With reference now to figure 1, an imaging apparatus **10** such as an image output device, printer, server and the like, receives a stream of image data **12**. The data is preferably compressed according to a token or pattern matching process such as JBIG2 or other compression techniques which store single copies of patterns in a document. Those skilled in the art, however, will appreciate that the teachings here are equally applicable to other pattern-based substitution processes. Included in the stream of image data **12** are coded image content data **14** or representations and a decoding pattern dictionary **16** or database. The coded image content data **14** carries a token identifier that points to or represents a particular token in the dictionary **16**. The dictionary **16** contains image patterns substitutable for the coded image content data **14** upon output processing. For example, a document may be compressed by storing only a single electronic representation of the letter "a." The coded image content data **14** includes an identifier instead of an entire bitmap representation anywhere the letter exists in the document. The identifier indicates a location in the decoding pattern dictionary **16** containing a single stored instance of an output-ready representation of the letter. Those skilled in the art will appreciate that in addition to text patterns for individual letters, similarly groups of characters also repeat frequently enough to usefully contribute to compression schemes. Likewise, other repeating image characteristics compressed by a token or pattern matching process will benefit from the teachings of the present invention.

[0023] A decompression processor **20** within the apparatus **10** receives the image data **12**. In one embodiment, the processor **20** first identifies and

decompresses only the decoding pattern dictionary **16**. Because the decoding pattern dictionary **16** ideally includes only single instances of tokens or patterns, it will typically be smaller than the coded image content data **14**. A dictionary image processor **22** revises or performs image output processing on individual image patterns in the decoding pattern dictionary **16**. The revision includes conventional image quality improvements, anti-aliasing, morphological operations such as edge enhancement, dilation, erosion and others that are readily implemented by those skilled in the art. Alternatively, the revision processing includes selective gray-scaling, color matching, font substitution and other image processing which tends to be output device specific. In the illustrated embodiment of the invention, the apparatus **10** replaces substantially all of the original image patterns in the decoding pattern dictionary **16** with their respective revised image patterns before the coded content **14** is decoded.

[0024]   With continued reference to figure 1, to produce a hard copy output of the compressed digital image, the apparatus **10** then decompresses or decodes the coded image content data **14**. The coded image content data **14** is parsed and a token identification corresponding to a location in the decoding pattern dictionary **16** is extracted. The decompression processor **20** then enters a revised dictionary **24** with the location **26** and returns with the revised image pattern **28** to be output or otherwise further rendered **30**.

[0025]   With reference now to figure 2, an alternate embodiment processes the image data **12** substantially coincident with its reception. An imaging apparatus **10'** receives the stream of image data **12** comprising coded image content data **14** and a decoding pattern dictionary **16**. The coded image data **14** is received sequentially by image processor **50**, and if the dictionary pattern at the address indicated by the image content data **14** has previously been revised or processed, the processor **50** dips into the revised dictionary **62** at location **64** identified by the coded image data **14** and extracts the corresponding revised symbol **66**. The revised symbol **66** is then provided for further image output processing **30** such as rendering or other pre-output image processing techniques.

[0026] With continued reference to figure 2, in the event the coded image content data **14** refers to a previously unrevised dictionary address, processor **50** extracts the original symbol or token **72** from the original dictionary. The original symbol **72** is then processed **74** or revised in order to be optimized with a particular output device or other desired processing as disclosed herein. The revised symbol **78** is then provided both to the revised dictionary **62** and the decompression processor **50**. The decompression processor **50** outputs the revised token **78** for processing **30**. Those skilled in the art will appreciate that the two dictionaries, i.e. original dictionary **16** and revised dictionary **62**, employed in the discussion and figure are for clarity only. Equal functionality and increased efficiency may be had by replacing original patterns with revised patterns in the same dictionary.

[0027] The invention has been described with reference to the preferred embodiment. Modifications and alterations will occur to others upon a reading and understanding of the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.